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# MITE ANTIGEN CONCENTRATIONS IN HOUSE DUST AND THE OCCURRENCE OF WHEEZING IN CHILDREN WITH DUST MITE ALLERGY

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## ABSTRACT

We studied the relationship between dust mite antigen concentrations in house dust samples and the occurrence and frequency of wheezing in 58 children with dust mite allergy (wheal $\geq$ 4 mm. mean diameter in response to a prick test with either D. farinae or D. pteronyssinus antigen). According to their parents, 15 subjects had never experienced recurrent wheezing, 8 had a history of past recurrent wheezing but no recent wheezing, and 35 had a history of recent wheezing. Spirometry data were obtained with a water seal spirometer and a limited dose methacholine challenge (total cumulative dose = 6.4 micromoles) was performed. Dust samples were obtained from 6 sites in each home: the child's mattress, blanket, pillow, bedroom floor, and the recreation room couch and floor. Der fI antigen concentrations were assayed using a monoclonal antibody based ELISA and expressed as ng/gm sieved dust. Concentrations of Der fI were $\geq$ 10,000 ng/gm in at least one microenvironment in the bedrooms of 86% of subjects. Mean concentrations of mite antigen in different micro-environments did not differ significantly for dust mite allergic children with and without histories of recent wheezing. Among children who had experienced recent wheezing, mean concentrations of mite antigen tended to be higher in dust samples from homes of the 19 children who had experienced $\geq$ 5 episodes of recent wheeze than in samples from the homes of 16 children who had experienced fewer episodes of recent wheezing; however, differences in mean concentrations of Der fI in the microenvironments sampled were not statistically significant. Similarly, Der fI levels in dust samples were not related to spirometry, or to methacholine responsiveness. In this study, differences in the degree of home environmental contamination with mite antigen did not account for differences in the occurrence or frequency of wheezing, bronchial hyperreactivity, or lung function among children with dust mite allergy.

## INTRODUCTION

The prevalence of physician diagnosed asthma in school age children is approximately 3-5% while an additional 5-7% of school children experience recurrent wheezing which has not been diagnosed as asthma. Asthma has been an important cause of school absence and hospitalization among school age children for many years, and recent data suggest that its prevalence may be gradually increasing. We recently conducted an epidemiologic investigation designed to define more precisely factors associated with recurrent wheezing in childhood. In that study of 454 children, allergic sensitization to dust mite antigens was demonstrated in 67% of children with recent recurrent wheezing, and in 26% of children without wheezing. In this report we describe an investigation of mite antigen concentrations in house dust as a potential correlate of wheezing among children with dust mite allergy.

## METHODS

Subjects for the epidemiologic project were recruited from a general pediatric practice in Raleigh, N.C. In the initial characterization of the population, 176 children with positive dust mite skin tests were identified. A subset of 58 children of these children was selected for the current study; the sample included mite allergic children with and without histories of wheezing. Mite allergy was defined by immediate hypersensitivity skin testing with epicutaneous application of D. farinae (10,000 AU/ml; Grier Laboratories) and D. pteronyssinus (30,000 AU/ml; Holister-Steir) antigens. A wheal with a mean diameter $\geq$ 4 mm 15 minutes after skin test application was considered positive. Recent wheeze history was obtained from the child's parent using a self-completion questionnaire which included all symptom questions from the ATS-DLD children's respiratory health questionnaire.

Spirometry was performed using a water-seal spirometer interfaced with a microcomputer (Survey III, Warren E. Collins Inc.). Four replicate spirograms were obtained; reference data of Polgar (1) were used to obtain predicted values from the spirogram with the highest sum of FVC and FEV-1.

Methacholine challenge: Following a saline trial, serial two-fold increasing doses of methacholine (Provocholine) beginning at 0.03 micromoles were administered using a hand activated DeVilbiss nebulizer, model #40. The challenge was terminated when FEV-1 had declined to 80% of the post-saline FEV-1 or when a cumulative dose of 6.4 micromoles of methacholine had been administered. Spirometry was performed 45 and 90 seconds following each dose of methacholine and sequential doses of methacholine were administered every two minutes.

House dust samples were obtained between 12-1-91 and 3-15-92 with a vacuuming device which collected samples on 0.3 micron pore size glass fiber filters using a flow rate of 28 cfm. Separate samples were obtained from 6 locations in each home: the pillow, blanket, and mattress of the child's bed, the floor in the child's bedroom, the couch in the family room, and the floor in the family room.

Concentrations of Der fI, the major group I allergen of D. farinae, in dust samples were determined using a monoclonal antibody based ELISA (2) and expressed as nanograms/gram sieved dust.

Analysis: The natural logarithms of Der fI antigen concentrations were used in analysis. T-tests were used to compare mean antigen levels in different microenvironments in the homes of mite allergic children in different clinical categories.

## RESULTS

Geometric mean concentrations of Der fI ranged from 2829 ng/gm in pillow dust to 11,978 ng/gm in bedroom carpet dust. The proportions of samples with Der fI concentrations $\geq$ 10,000 ng/gm ranged from 31% of pillow samples to 61% of bedroom floor samples. At least one sample from the child's bed contained $\geq$ 10,000 ng/gm Der fI antigen in 66% of study homes. Concentrations of Der fI $<$ 2000 ng/gm in all three bedding samples were observed in only 20% of homes.

To determine whether concentrations of Der fI in dust from different microenvironments in the home were related to clinical status in study children, subjects were categorized into four groups based on lifetime wheezing experience as reported by parents. Analysis groups consisted of children who had experienced: 1) 5 or more episodes of recent wheezing (in the two years before dust sampling; n=19), 2) recent wheezing but less than 5 episodes (n=16), 3) past wheezing (n=8), and 4) children who had never experienced wheezing (n=15). Methacholine challenge data supported the clinical categorization of study subjects. Seventy-four percent of children who had experienced 5 or more episodes of recent wheezing responded to $\leq$ 3.2 micromoles of methacholine compared to 38% of children with milder recent wheezing, and 19% of children who had never experienced wheezing.

Figure 1 shows the distribution of maximum Der fI concentrations observed among the three dust samples obtained from each child's bed by clinical status. At least 50% of children in all clinical categories slept in beds contaminated with $\geq$ 10,000 ng/gm of Der fI antigen; the proportion of children with dust mite allergy and recent wheezing who slept in beds with high levels of Der fI contamination (60%) was slightly less than, but similar to, the proportion of children with mite allergy but without wheezing who slept in highly contaminated beds (76%). Among children with any recent wheezing (groups 1 and 2), children who had experienced less frequent wheezing tended to live in homes with lower concentrations of Der fI in dust samples. However, geometric mean levels of mite antigen did not differ significantly in any microenvironment sampled when children with frequent recent wheezing were compared to children with less frequent wheezing. The maximum difference in mean mite antigen concentrations was observed when the mattress dust samples obtained from the homes of children with 5+ episodes of recent wheezing (geometric mean = 12,110 ng/gm) were compared with the similar dust samples from the homes of children with histories 1-4 episodes of recent wheezing (geometric mean = 2,581 ng/gm; p = 0.06). When children with any recent wheeze were categorized into those with FEF 25-75 $\leq$ 70% predicted and/or FEV-1/FVC $\leq$ 75% (n=13) and those who had neither of these traits (n=22), no differences in the degree of Der fI antigen contamination of home microenvironments were observed.

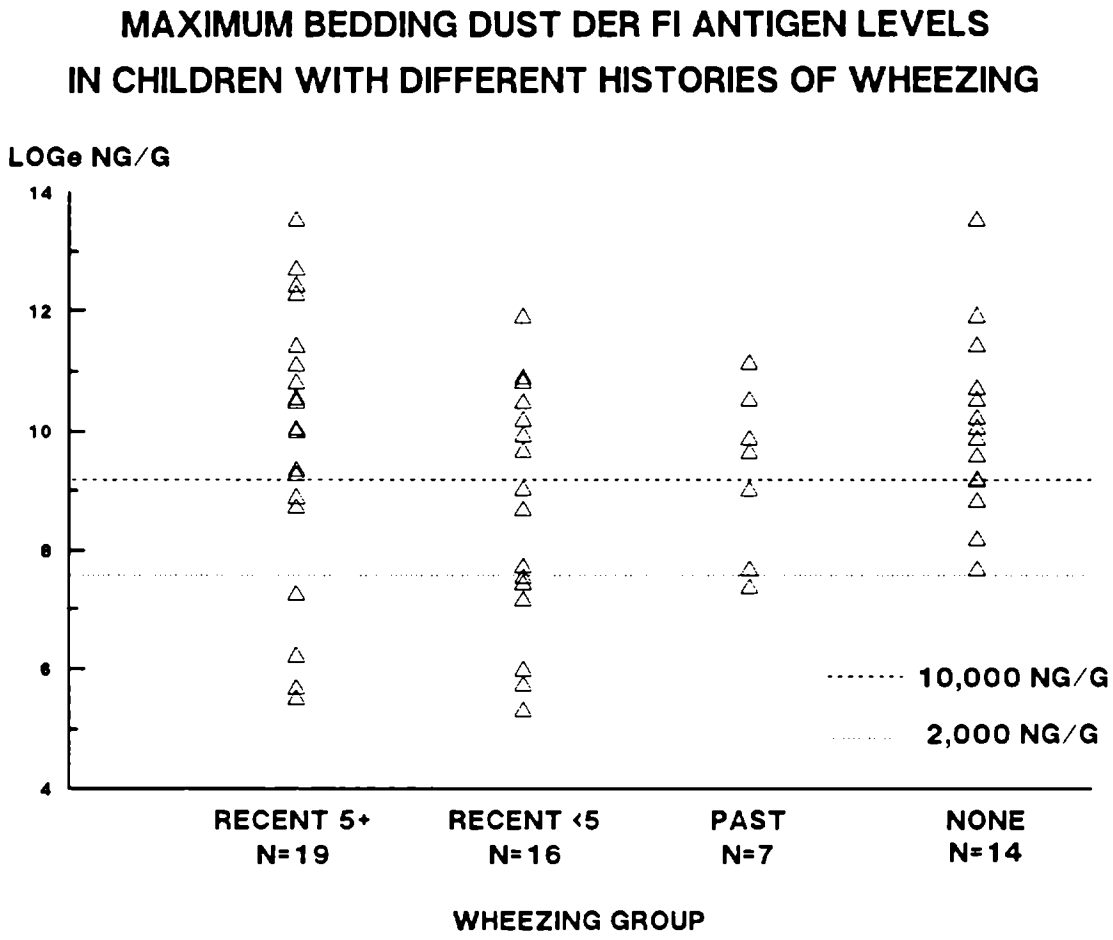


Figure 1. Maximum bedding dust Der fI antigen concentrations in samples from homes of children with different histories of wheezing.

## DISCUSSION

Dust samples obtained during the winter months from homes of mite allergic children in central North Carolina frequently yielded high concentrations ($\geq$ 10,000 ng/gm) of the major group I allergen of D. farinae, Der fI. We identified no significant differences in the distributions of F1 levels in dust samples from six different sites within the home when data from the homes of mite allergic children with and without wheezing were compared. Furthermore, we found no significant differences in the distributions of mite antigen concentrations in dust samples from homes of children experiencing frequent wheezing compared to children experiencing less frequent wheezing. In addition, neither lung function nor methacholine response data provided evidence that mite allergic children with more severe airway dysfunction resided in homes with higher levels of mite antigen in bedding, furnishings, or carpeting.

The observation that more than 75% of mite allergic children who had not experienced wheezing slept in beds contaminated with high concentrations of Der fI, indicates that

certain mite allergic children are resistant to mite allergy-associated wheezing and bronchial hyperreactivity even when mite antigen exposure is high. It is possible that we studied too few homes with low levels of mite antigen contamination to demonstrate a relationship between level of mite antigen contamination and severity of lower respiratory disease among children who manifested both mite allergy and wheezing. Therefore, these data should not be construed to suggest that protection of mite allergic children from mite antigen exposure would not be associated with amelioration of the severity of clinical disease.

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